Asteroid Radar Astronomy at Goldstone in the 1990s

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Between 1/90 and 6/94 the Goldstone λ3.5-cm (85 1O-MI17) radar has detected 11 asteroids: 4 Vesta, 7 Iris, 97 Klotho, 324 Bamberga, 1981 Midas, 3103 Eger, 4179 Toutatis, 4953 (1990 MU), 5189 (1990 UQ), 1990 MF, and 19900S. 1/or Klotho, excellent agreement between radar cross sect ion est imates from Goldstone in 1994 and Arecibo in 1981 confirms the accuracy of the two telescopes' long-term, relative calibration. Echo bandwidths place the following lower bounds on D/P, where D (km) is the maximum pole-on breadth and 1' (h) is the rotation period: 0.5 for Midas, 1.2 for 1990 MU, 0.13 for 19900S, and 0.10 for 1990 UQ.

Since 1990, much effort has been devoted to optimizing Goldstone's capabilit y to study near-liarlh objects (NEOs). Three different configurations arc now available. The nominal system on the 70-m antenna (DSS14) uses separate feed horns for t ransmitting and receiving, and the> 15s required for TX/RCV switching renders the system useless for targets much closer than -0.025 AU (~10 lunar distances, -25 s of echo time delay) and unwieldy even for targets twice that far. However, an additional, recently inst alled single-lmrn system (S1 IS, first used for J 990 MU) shrinks the switching t imc to ~5 s, letting DSS 14 observe NEOs as c1osc as -5 lunar dist ances. Closer targets will require two-station observations, with DSS 14 transmitting cent inuously while DSS13, a 34-m antenna 22 km away, receives. That configuration, first used for Toutatis, will also be required for delay-]JoJ>plcr imaging that places thousands of pixels on any NEO whose rotation period 1' (h) and echo roundtrip time delay RTT (s) satisfy 1'> RTT.

During the next two years, seven asteroids are scheduled for Goldstone observations. Delay-Doppler imaging experiments, expected to resolve the target into ≥100 cells, arc planned for 162.0 Geographos in 8/94 and 1991 JX in 6/95.

After complet ion of the Arecibo upgrade, Goldstone will play an important complement ary role to that much more sensitive instrument. Arecibo will see t wice as far and cover three times as much volume as Goldstone, but Goldstone will have solid-angle and hour-angle windows equal to two and three times those of Arecibo. Goldstone will extend the rotational and orbital phase. coverages for targets visible at both sites, and will help to secure the orbits of NEOs discovered after their exit from Arecibo's declination window.